August 12, the heads were examined for seed, and the 11 heads present, with 293 florets, yielded 90 seeds, or 30 per cent.

These observations and experiments are simple but conclusive. They prove that *Tetralonia dilecta* pollenizes red clover to an important extent in the latter part of May and in June (in central Illinois), and that *Melissodes bimaculata* also is an efficient pollenizer of plants that bloom during July.

The present summary is simply for the purpose of placing these facts on record; a detailed account of further studies being left for a future article.

ARE THERE TWO SPECIES OF THE OYSTER-SHELL SCALE?*

Grace H. Griswold.

The Oyster-shell Scale (*Lepidosaphes ulmi*, L.) has been a subject of study on the part of the writer since the spring of 1919. During the summer of that year, observations were made on the biological development of this insect on lilac. In the fall, while making egg counts from various host plants, it was noticed that the scales formed on apple trees seemed to differ in appearance from those on lilac and some of the other ornamental shrubs and trees. It was therefore determined to make a comparative study of the biological development of the insect on apple and lilac the following summer.

Studies of this insect have resulted in the finding of three distinct differences between what may be called the apple and lilac forms:

1. Differences in the appearance of the scales.
2. Differences in biological development.
3. Differences in morphological characters.

* Contribution from the Entomological Laboratory, Cornell University, Ithaca, N. Y.

DIFFERENCES IN THE SCALES.

The new scales formed on apple are of a uniform brown, while the new ones on lilac are traversed by distinct stripes or bands. These bands, three or four in number, are light brown in color and vary in width from those that are quite wide to those that are mere strips. The old scales on apple are of a very dark uniform brown, sometimes of a slight grayish tint. The old scales found on lilac, on the other hand, are of a very pale gray, sometimes almost white, and the bands can be distinctly seen. These differences are uniform and constant in all specimens.

DIFFERENCES IN THE BIOLOGICAL DEVELOPMENT.

During 1919, 1920, and 1921, careful observations were made on the biological development of the insects on lilac. In 1920 and 1921 the biological development of the insects on apple was also studied. The differences in the development of the apple and lilac forms are most clearly shown by means of a table.

	1919	1920		1921	
	Lilac	*Apple*	*Lilac*	*Apple*	*Lilac*
Eggs hatched	June 7	May 31	June 14	May 6	May 27
First molt	June 21	June 16	July 2	June 1	June 20
Second molt	July 17	July 8	July 29	June 24	July 7
Egg laying began	Aug. 19	Aug. 5	Aug. 31	July 22	Aug. 5

It will be seen from the table that the apple form develops from two to four weeks ahead of the lilac form. The cold summer of 1920 seems to have retarded the development of the insects on lilac more than of those on apple, for the lilac insects were nearly four weeks behind those on apple in beginning to lay their eggs. In 1921, however, there was a difference of about two weeks in the development throughout the entire season.

DEVELOPMENT ON DIFFERENT HOST PLANTS.

In connection with the study of the biological development, some transfer experiments were carried on in an effort to learn if the apple and lilac forms are interchangeable as far as host plants are concerned. Small pieces of twigs, badly infested with scale, were tied to clean, uninfested branches of various trees, each branch being then covered with a bag of fine cheese cloth. In every case the eggs hatched and the young larvæ crawled to the new host plants in large numbers. The results of these experiments were as follows:

TRANSFERS FROM APPLE TO OTHER PLANTS.

Plants to which transfers were made	Result
Lilac, Poplar.	Very successful. Many completed their development and laid eggs.
Willow, Choke cherry, American ash.	Fairly successful and about in the order named. Some completed their development and laid a few eggs.
Red maple.	Many became adult and started the third or permanent scale.
American elm, Box elder.	On the elm, 2-3 became adult, then died. On box elder only one became adult. In both cases many were found to have died in the second instar.
Pussy willow.	None were found in the adult stage. A few started the second scale and then died.

TRANSFERS FROM OTHER PLANTS TO APPLE.

Plants from which transfers were made.	Result
European ash, Lilac (2 places), Willow, Lombardy poplar.	All the larvæ died in the first instar.

TRANSFERS FROM OTHER PLANTS TO PEAR.

Plants from which transfers were made.	Result
Lilac.	Many larvæ were found on the twigs, having died in the first instar. A few had started the first scale.
Large toothed aspen.	Many larvæ formed the first scale, others died without any effort at making one.

It will be noticed that while transfers were successful from apple to other trees, in no case could insects of the lilac form be made to live for any length of time on apple or pear. Although the young larvæ crawled on the apple and pear twigs, in every instance they died while still in the first instar. The scales made by the apple form on the new host plants were always of the uniform brown so constant on the apple.

DIFFERENCES IN MORPHOLOGICAL CHARACTERS.

No differences have as yet been found in the pygidial fringe of the apple and lilac forms. Several writers, however, have called attention to the variation in the number of circumgenital pores of the Oyster-shell Scale from different host plants. For example, Cockerell (1895) mentions finding specimens on dogwood in California that had fewer pores than are usually noted on apple. Frank and Kruger (1900) give sample counts of these pores from apple, plum, thorn, poplar, and willow. Glenn (1920) also counted the pores from various host plants. These observations suggested the desirability of making extensive counts of these pores from insects on apple and lilac. Knowing that a study of the pores would be of little value unless made from a long series of specimens, approximately 550 insects were mounted and their pores counted, 277 from apple and 272 from lilac. Instead of putting the data in tabular form, giving maximum, minimum, and average counts, variability curves were plotted such as are commonly used by workers in genetics to show fluctuating variations. The information desired was not the average number of pores in a group, but the number of pores found to occur most commonly.

The accompanying diagrams show these curves. The abscissæ indicate the number of pores found in the various groups examined, while the ordinates indicate the proportion of groups in which the varying numbers of pores occurred. To make the curve for the posterior lateral groups of the apple form, pores were counted in 496 groups. These pores were found to vary in number from 6–24 in a group. Only one group (0.20% of the total number of groups examined) had as few as 6 pores and only one group had as many as 24 pores. On the other hand, 72 groups (14.51%) had 11 pores, 100 groups (20.16%) had 12 pores, and 80 groups (16.12%) had

13 pores. In the posterior lateral groups of the apple form the number of pores found to occur most commonly, then, is 12. Therefore, speaking technically, 12 is the "mode" of the apple form. The curve for the posterior lateral groups of the lilac form is based on counts of the pores of 485 groups. Of these groups, 64 (13.19% of the total number of groups examined) had 19 pores. The mode of the lilac form, then, is 19. Not a single group of the 485 examined from lilac had 12 pores, while only six (1.20%) of the apple specimens had 19 pores.

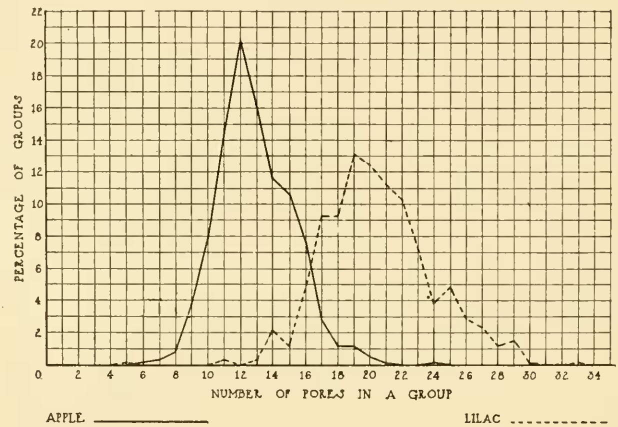

FIG. 1.

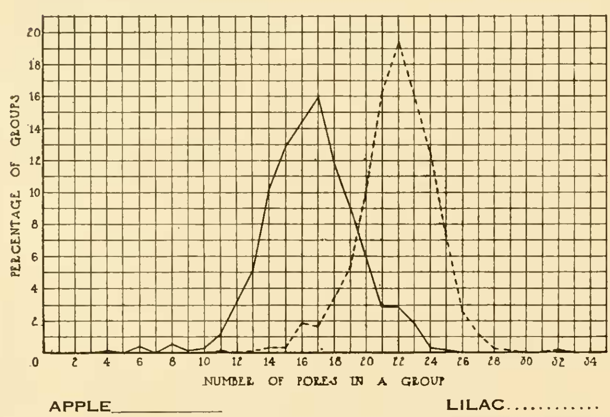

FIG. 2.

Fig. 1. Curves showing variation in the number of circumgenital pores of the posterior lateral groups of the apple and lilac forms. The curves are based on counts of the pores of 496 groups of the apple form and 485 groups of the lilac form.

Fig. 2. Curves showing variation in the number of circumgenital pores of the anterior lateral groups. The curves are based on counts of the pores of 490 groups of the apple form and 485 groups of the lilac form.

Practically the same thing holds true of the anterior laterals. Here the mode of the apple form is 17, while that of the lilac is 22. In the case of the median group the difference is less marked, yet each form has its mode, that of the apple being 11, while that of the lilac is 13. The greatest contrast is seen in

FIG. 3.

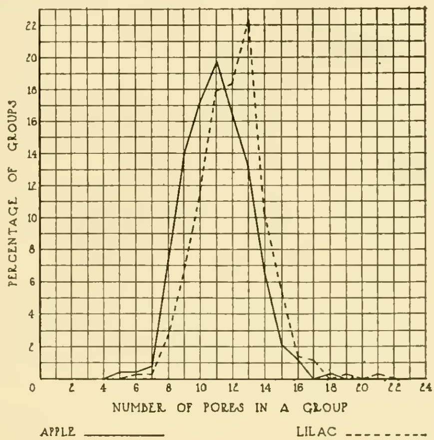

FIG. 4.

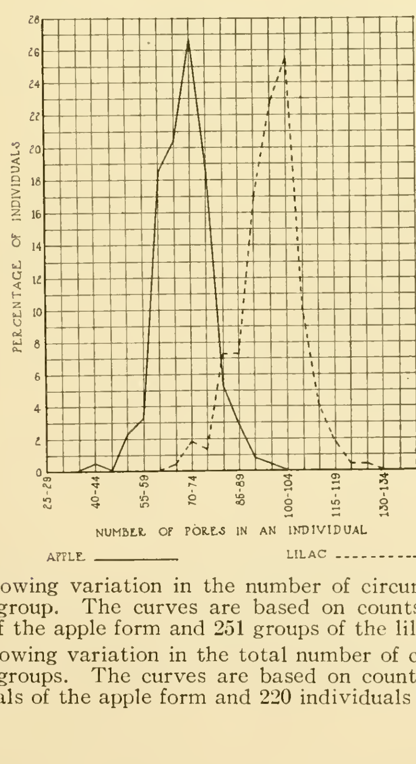

Fig. 3. Curves showing variation in the number of circumgenital pores of the median group. The curves are based on counts of the pores of 243 groups of the apple form and 251 groups of the lilac form.

Fig. 4. Curves showing variation in the total number of circumgenital pores of all five groups. The curves are based on counts of the pores of 210 individuals of the apple form and 220 individuals of the lilac form.

the diagram representing curves for the total number of pores of all five groups. In order to plot these curves at all it was necessary to place the insects in classes with respect to the number of pores, for example, those having 65–69 pores, 70–74, 75–79, etc. The curve for the apple form shows that the total number of pores for an individual is most commonly 70–74. In other words, the mode of the apple form is 70–74, while that for the lilac form is 100–104. Only five insects of the 220 examined from lilac had as few as 74 pores, while not a single apple insect was found to have 100 pores, and only three had as many as 90.

A study has been begun of the pygidium of the second instar. This pygidium resembles, in many ways, that of the adult insect, though of course, it lacks entirely the circumgenital pores. The dorsal and marginal gland openings can be distinctly seen, there being eight marginal gland openings (four on each side) in both the apple and lilac forms. Sufficient material was not available for a careful study of the dorsal gland openings, but all the specimens examined showed more of these openings present in the lilac than in the apple form. In the lilac form they varied from 14–18, while in the apple they ranged from 8–12. It is planned to secure during the coming summer, material for a more careful study of the gland openings of the pygidium of the second instar.

HOST PLANTS OF THE TWO FORMS.

Examination of the scales and counts of the circumgenital pores show that insects found on the following host plants belong to the apple form:

Red dogwood (Cornus alba).
Alternate leaved dogwood (Cornus alternifolia).
Round leaved dogwood (Cornus rugosa).
Mountain maple (Acer spicatum).

The biological development of the insects on red dogwood, which has been studied, paralleled that of the apple form.

The lilac form was found on:

American ash (Fraxinus americana).
European ash (Fraxinus excelsior).
Fringe tree (Chionanthus virginica).
Golden current (Ribes aureum).
Laurel leaved willow (Salix pentandra).
Heart leaved willow (Salix cordata).

New Jersey Teå (Ceanothus americanus).
Large toothed aspen (Populus grandidentata).
Carolina poplar (Populus eugenii).
Lombardy poplar (Populus nigra, var. italica).
Trembling aspen (Populus tremuloides).
Witch-hazel (Hamamelis virginiana).

The biological development of the individuals occurring on American ash, European ash, fringe tree, laurel leaved willow, large toothed aspen, and Lombardy poplar has been followed and found to agree closely throughout the life cycle with that of the lilac form.

In conclusion it may be said that the evidence certainly seems to justify an affirmative answer to the question, "Are there two species of the Oyster-shell Scale?"

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A STUDY OF THE WING VENATION OF THE COLEOPTERA.*

By S. A. Graham.

The purpose of the modern taxonomist is not satisfied by the mere arbitrary naming of an insect. Taxonomy is more than that. If the worker in this field is true to the highest ideals of his profession he must continually strive to clear up some of the multitude of problems associated with the natural relationship of the organisms with which he is dealing, and to show this relationship in his classifications.

Unfortunately valuable phylogenetic characters are sometimes accidentally overlooked and remain in obscurity. It is not until we take advantage of all these available characters that we can hope to arrive at a true expression of phylogenetic relationship.

In the Coleoptera the characters to be found in the hind wings are undoubtedly of considerable value, but have been almost entirely neglected in taxonomic studies. This is

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